

From the house of Amar Chitra Katha and Tinkle

BRAINWAVE™

SCIENCE IS JUST A GAME

Vol. 02 Issue 06
June 2013
48 pages
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BLAST!

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At the outset, I liked the last issue, especially its appearance. The content is also very rich. I do appreciate the entire team's effort to present something that is reader-friendly and educative. In short, its edutaining - Dr. AS Manekar, Dy. Director General, National Council of Science Museums



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Back to School!

Dear young readers,

It is the end of summer vacations. Are you excited that you are going back to school? Personally, I am sad that the season of mangoes is fast drawing to an end. I never seem to be able to enjoy enough of them!

Have you enjoyed the April and May issues of Brainwave? Go to school and boast of all that you have learnt from them - be a science superhero!

This year too, we continue our quest to make science simpler and more exciting for you. In this issue, we discuss all about chemistry, its evolution and why you should study it - through stories, comics, fun-to-do activities and contests. Enjoy!

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In which we learn to love chemistry by breaking a bunch of test tubes, witnessing a cool irreversible reaction and reading about super chemical bloopers...

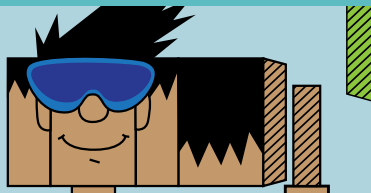
■+ A CHEMICAL BLAST

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MEET THE SMARTIES



Dr. Dodo: Dr. Dodo is the co-founder of BW Labs and is the last living dodo. He holds a PhD in anachronomaly and parallel universes from the University of Clockwindistan. He invented the Galileo series of time machines.



Skree!: Skree! is the other founder of BW Labs. She loves dangerous experiments. She makes mini black holes before breakfast and has dark matter for lunch.



Arby: Arby is a genius who will grow up to be Aryabhata. He came to the future, thanks to Dr. Dodo's time machine. He is a fan of numbers, banana fritters and robot wars.



Mr X: Mr. X, short for Xavier, was once Dr. Dodo's student. X is as brilliant as Alby and Arby, and by virtue of his knowledge of science, as powerful as Bhoo when the situation demands.



Bhoomi: Bhoomi, a.k.a. Bhoo, is an enigma. No one knows where she is from and how she came into being. She is made up of earth, wind, fire, and water in equal parts. Her alter-ego is Gaia Goel, a world famous science sleuth.

Alby: Alby will grow up to be Albert Einstein. However, now, like Arby, he too has been sucked into the future. When he is not researching, he plays the violin.





Artwork: Sarthak Sinha

Be a Smartenstein!

We run more than ten activities and contests in each issue. They can win you many exciting prizes.

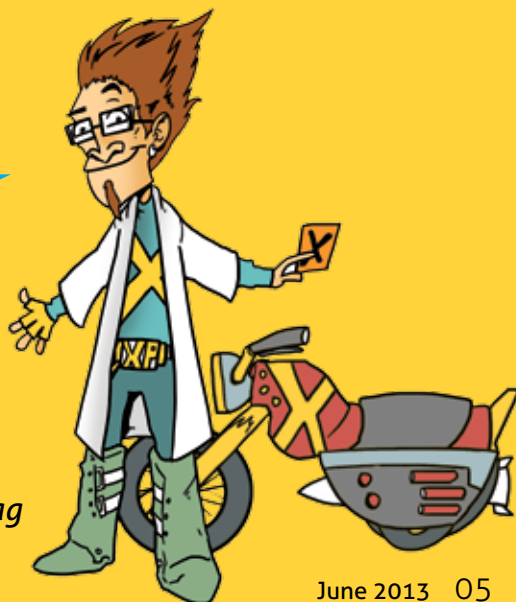
Participate in all the activities of an issue, and you can win a merit certificate, the title 'Smartenstein' and a mystery gift - every month!

There are 13 other activities and contests in this issue: 'Toy Box **p8**', 'Ask us Why **p7**', 'Eye See **p27**', 'Third Law **p34**', 'Fan Fiction **p26**', 'Planet Ninjas **p35**', 'Magic Science **p35**', 'Practical Science **p21**', 'DIY **p24**', 'Fun-do Band **p45**', 'Super-teacher Awards **p45**', 'Treasure Hunt **p46**' and 'Sci-Q Time **p47**'.

www.bwmag.in/category/bw-smartenstein

Join us on our fun-do video channel as *Mr. X* performs some amazing experiments and *x-plains* the science behind them.

Mr. X will perform and publish your experiments too! Just email them to brainwave@ack-media.com



www.youtube.com/Brainwavemag

Artwork: Abhijeet Kini

Winners of various activities in the April 2013 issue are:

Toy Box: **Raveendranath B**

Ask Us Why: **Chayanika Biswas**

Eye See: **Ritvik Upadhyay**

Fan Fiction: **Pratul Venkatesh**

Third Law: **Revanth Kausikan**

Planet Ninjas: **Swayam Das**

Magic Science: **Ritvik Upadhyay**

Sci-Q Time: **Maullick Gupta**

Science Fiction: No one

Ritvik and **Pratul** get nominated for the BW Student Board. For more details, visit www.bwmag.in/student-board

The BW Smartenstein title, certificate and mystery gift for March go to **Ritvik Upadhyay**. For more details, visit -

www.bwmag.in/category/bw-smartenstein

All Fun-do Band captains - ensure that each of your team members visits and registers individually at www.bwmag.in/fun-do-band Your team membership will be activated only after that. If you face any issues during the process, write to brainwave@ack-media.com

May 2013 winners will be declared in the July 2013 issue.



Letters from Readers

Hi, I love brainwave a lot. I also suggest all readers to spread brainwave to their friends. It is a wonderful monthly magazine. I am really addicted to it. Reading brainwave improves your knowledge a lot. It is a very useful magazine for all science lovers. Thank you. **Madhumitha Dilip**, via email.

Dear **Madhumitha**,
We are glad to receive the email from you. Keep reading Brainwave, writing to us and sharing the knowledge with friends. Knowledge is the one thing that multiplies when you share!
SK, Editor

There is a mistake in the April issue of brainwave (in the cover story) because if **Trillan's** spaceship reached the speed of light,

the mass of the spaceship would become infinity and you cannot travel faster than the speed of light. Also, if **trillan** travelled at the speed of light to reach the Himalayas she would have circled the earth 7 times in one second. **Ritvik Upadhyay**, Via email.

Dear **Ritvik**,
As mentioned in my email response to you, now that you have read *Mysteries Aplenty - 2*, do you know how travel at speeds greater than the speed of light is possible? Have you researched what wormholes are?
SK, Editor.

I would like to share this video with all Brainwave readers. It is called a *Rube Goldberg Machine*. It is a deliberately over-engineered machine that performs a very simple task in a very complex fashion. A competition is also held for the same. An example is - http://www.nytimes.com/2012/01/08/nyregion/brooklyns-joseph-herscher-and-his-rube-goldberg-machines.html?_r=2&ref=technology. Do watch it. Awesome video, Isn't it??
Nachiketa S R, via email.

Dear **Nachiketa**,
Fortune favours the brave, doesn't it? :)
SK, Editor.



RISE THE MILK-E-WAY

Why does milk overflow when boiled
whereas water does not?

by Srinath Perur

Milk is mostly water plus some sugars, proteins, minerals and fats. When milk is boiled, some of these substances rise to the surface of the milk, forming a skin on the top. Once the skin forms, the steam that is produced in the milk cannot escape.

This further increases the temperature of the milk and gives us what is called super-heated milk. This milk is at a temperature above its boiling point, and is waiting to let off the steam.

As anyone who's had a cappuccino knows, milk tends to foam when you persistently apply steam to it. That is, the milk tends to trap tiny bubbles and increase in volume.

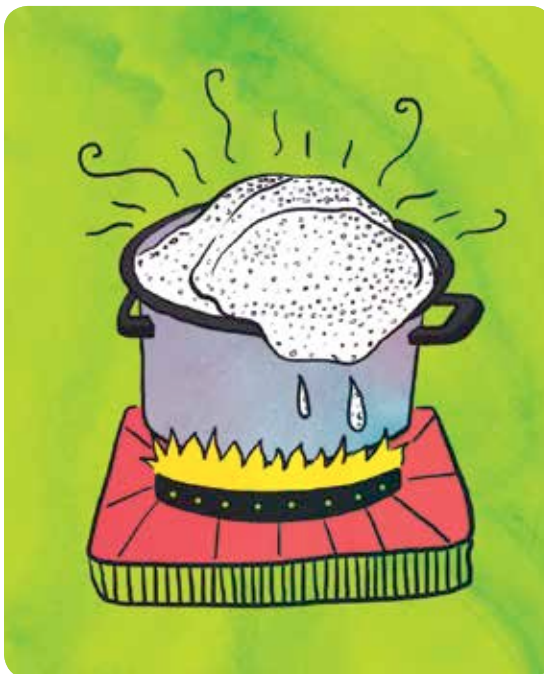
This is exactly what happens when we boil milk and steam cannot escape. After a point, milk begins to foam and pushes the skin up. This is the time to run and turn off the stove. Otherwise the super-heated milk lets out some more steam. This creates more foam, and so on, until

suddenly, there is a lot of foam pushing the skin up. When the skin reaches the top of the vessel, the foam and milk spill over.

How do we prevent milk from boiling over?

One solution, which you may already know, is to boil milk in what is called a 'milk cooker'. This is a vessel, the walls of which contain water. So, heat is transferred to the milk through water. Since the temperature at which water boils is slightly less than that at which milk boils, milk does not get super-heated.

Another trick is to keep a long wooden spoon in the milk while it boils. This prevents the skin from completely covering the milk's surface, allowing the steam to escape. ■



Have a burning question? Email us at brainwave@ack-media.com with 'Ask Us Why' as the subject. The best question will win two cool Amar Chitra Katha comic books!



COOL CHEMISTRY, MYSTERY REACTION

by Kayomarz Bacha

To perform this,
you need:

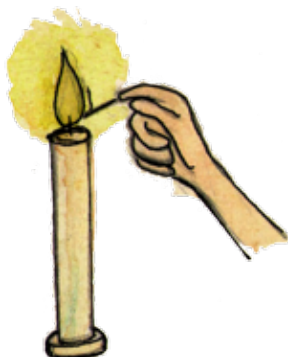
- A glass
- Some vinegar
- Baking soda
- Candle
- Lighter / matchbox



METHOD:

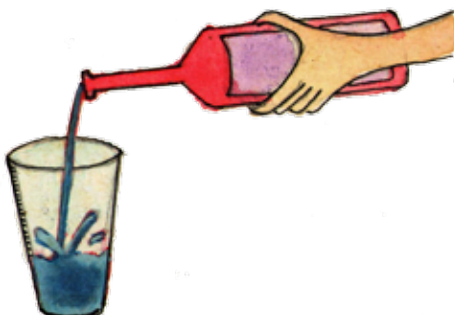
Step 1

Light the candle.



Step 2

Pour some vinegar into the glass.



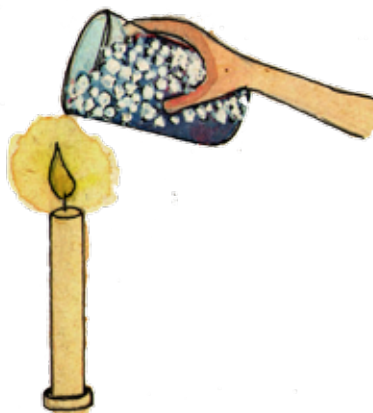
Step 3

Add a spoon of baking soda to the vinegar.



Step 4

Tilt the glass over the flame, as if to pour the solution on it.



NOTE: Don't actually pour the solution on the flame. Let science do the trick! ■

Why does this happen?

Mixing the vinegar and baking soda causes a simple acid-base chemical reaction, forming carbon dioxide (CO_2).

The CO_2 first fills up the glass and once the glass is full, starts overflowing. The action of pretending to pour the solution over the flame directs the overflowing CO_2 onto the flame. This causes the flame to extinguish.

The **chemical equation**^G:

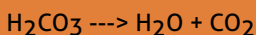
Vinegar is nothing but acetic acid: CH_3COOH

Baking soda is sodium bicarbonate: NaHCO_3

As mentioned, this is simply an acid-base reaction.



H_2CO_3 is carbonic acid. This quickly decomposes into carbon dioxide and water:



This CO_2 is what you see foaming and bubbling in the glass.



What are acids? What are bases? What is an acid-base reaction?
What are the most common examples of an acid-base reaction?

Research these questions and email your answers to brainwave@ack-media.com
The best answer wins a digital copy of our upcoming DIY book - 'Totally Fun-to-do Science'!

A CHEMICAL JOURNEY

Written by Jayadev Calamur
Artwork by Parvati Pillai

Sitting in a laboratory, one sometimes wonders how a liquid changes its properties (like colour and odour) when mixed with another.



The evolution of chemistry is an interesting tale. It began when primitive humans realized that friction causes heat, which can help create fire.

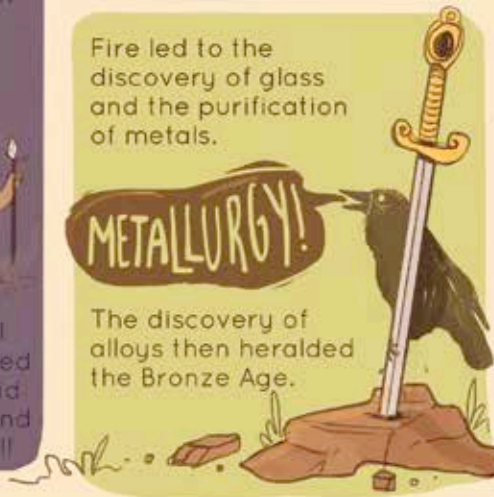


This was the first chemical reaction used in a controlled manner. Of course, they did not know the science behind it! To them, it was mystical!

Fire led to the discovery of glass and the purification of metals.

METALLURGY!

The discovery of alloys then heralded the Bronze Age.



Ancient Greeks and Indians came to believe that all matter is made up of smaller primary elements. Greek philosopher Democritus and Indian philosopher Kanada declared that the atoms were the most indivisible parts of matter.



Till then, all civilizations including Greek, Indian, Mayan and Chinese believed that **Air, Earth, Wind and Fire** were the primary elements. Without scientific proof, the existence of atoms was easy to deny.



Earth

Fire

Wind

Water

And Aristotle, the teacher of Alexander the Great did just that - he opposed the existence of atoms. This was in 330 B.C.!

Soon, gold became a precious metal and people started working towards converting metal to gold. This was called alchemy.



Alchemists also worked on creating the Elixir of Life, which we know better as the Philosopher's Stone.

In the 8th century, Persian alchemist, Jabir Ibn Hayyan took an experimental and scientific approach to alchemy. He showed a clear recognition of the importance of experimentation. He is credited with the use of chemical laboratory equipment, the description of chemical processes such as crystallization and distillation, substances like citric acid, bismuth, sulfur and mercury. Nearly 3000 treatises and articles are credited to him!



Robert Boyle is considered to have refined the modern scientific method for alchemy and to have separated chemistry further from alchemy.

French scientist Antoine Lavoisier, credited as the father of modern chemistry, developed the law of conservation of mass. Thus, chemistry acquired a strict quantitative nature, allowing reliable predictions to be made.

By the late 1800s Mendeleev developed the modern periodic table and could predict the existence and properties of undiscovered elements!



John Dalton, in the early 19th century, came up with the atomic theory of matter that stated that elements were made up of discrete units called atoms.

Though in the 19th century scientists were divided into two groups - those who followed the atomic theory and those who didn't, the 20th century has seen advances such as nuclear and radiochemistry, quantum chemistry and molecular biology.

Chemistry helps us in the production of many common materials of the modern world - synthetic fibers, plastics, paints, detergents, pharmaceuticals, adhesive, fertilizers and more. All electronic devices, especially computers, exist today due to integrated circuits that are possible because of chemistry!

What will
the future of
CHEMISTRY
hold? Only time
CAN TELL.



Is Organic the Way to Go?

The research folks are always up to something. This time, they put tomatoes through a tough test!

When tomatoes grow organically (without the help of fertilizers) they go through a fair amount of stress to fight pests. This is similar to our body releasing antibodies to fight diseases. This stress though, makes them sweeter and more nutritious.

But the research, held at the Federal University of Ceara further, states that organically grown tomatoes turn out to about 40% smaller in size.

Hence, we conclude that fruits and vegetables should be grown by balancing plant stress with efforts to maximize yield and size, rather than follow any one method. ■

Source: sciencedaily.com

Wounds Will Now Heal Faster!



Everyone hates wounds and the restrictions that come along with them. Now, there is hope for us all!

When any part of our body gets bruised, a molecule known as basic fibroblast growth factor, or bFGF, is secreted by our cells to trigger processes that are involved in healing. But, bFGF behaves unstably once outside the body.

Now, Heather Maynard and other researchers at UCLA's

NanoSystems Institute have found a way to stabilize bFGF and hasten healing.

The ability to stabilize bFGF means that it can be potentially stored, shipped and used by doctors when patients need it. This achievement will prove beneficial especially for patients suffering from diabetes because their wounds heal very slowly. ■

Source: sciencedaily.com

Welcoming 'Fire Ice'



Japan has done it! It is officially the first country to tap natural gas from sea-bed deposits of methane hydrate successfully.

This discovery is highly significant as this gas could well be the next major source of energy for Japan. Japan currently imports almost all of the fuel needed to meet its energy needs.

Around 40 trillion cubic feet of methane hydrate were discovered near Japan's central coast. The natural gas tapped from this could turn out to be an estimate equal to about 11 years of Japanese gas consumption!

Methane hydrate, termed 'fire ice' is nothing but methane trapped in ice. It is called fire ice because when an open flame is brought closer to it, it releases the methane trapped inside and burns. Methane is a major component of natural gas.

Methane Hydrate is not easily found on the Earth because it can exist only in temperatures below -80°C . At 0°C , it can exist only under a high pressure of 23 atmospheres. ■

Source: dailymail.co.uk



Artwork: Souadnini Tamboy

A CHEMICAL BLAST KAYO TURNS GEEK!

Kayo is the resident geek at the BW Labs, we all know that. But how did he turn into this crazy geek-a-holic? Read on to find out.

by Priyanka Talreja

It was the January of 1992. Kayo's 13th birthday was close. But, Kayo was in his room, head stooped. He was upset. This was not natural since birthdays excited Kayo the most. Clearly, something was wrong.

At that moment, Kayo's mother entered the room. The somber atmosphere caught her off guard and worried, she asked him, "What is the matter? Why do you seem upset? Do you not like your new clothes? Or is something wrong with the party preparations?"

Kayo looked up with teary eyes and said, "No mom. All the party preparations are perfect. But, I am unable to finalize the theme. Last year, Minu held a party where we were all superheroes! She got us capes and lined up exciting games. I... don't know what to do..."

Kayo's mom thought over it for a few seconds and exclaimed, "Hey! Why don't you go ask Minu for help! She is good at such things and is

your close friend."

Kayo's face lit up, "That's a great idea mom! You are the best mom ever..." And even before he completed the sentence, Kayo was gone.

Minu was Kayo's neighbour and the only one with practical solutions to all his problems. He never admitted it when she was around, but deep down, he knew better.

He reached her home and was about to ring the bell when he stopped in his tracks and sighed, "Oh, no! Not again." He had realised from the smell of chemicals that Minu's mom was in the house.

Minu's mom absolutely loved chemistry. She was a renowned chemistry lecturer in one of the best colleges in town. She had a fully functional laboratory at home and whenever she had time, she performs experiments. Kayo, on the other hand, hated chemistry. He disliked chemical formulae and equations - they were tough to remember.

Highly annoyed, he covered his nose with a handkerchief and rang the bell. Minu opened the door. When she saw Kayo, she pulled the hankie out of his hand and said, "You're being rude! What if my mom saw you covering your face like this?"

"I am not being rude, Minu. The smell gives me a headache!" explained Kayo.

"In that case, let's go into





the study. The odour there won't be as strong," Minu suggested.

They quickly ran up the stairs and entered the study. But Kayo was as grumpy as ever. "Can we please use a room freshener? This place stinks just as bad!" he said, grabbing the room freshener and spraying it in abundance till Minu almost choked on it.

"Stop already!" Minu

said. "I love the smell of chemicals. It is an indication that something exciting is happening. What if my mom discovered a new formula? That would be so cool!"

But, Kayo wasn't listening. He inhaled the sweet smell and felt at peace. "This place is much better now," he said.

"Kayo, do you know that you have just used chemistry to help yourself?" asked Minu, with a sly smile.

"What? No way... chemistry stinks!" Kayo contradicted.

"When you sprayed the room freshener, the liquid inside the bottle changed into its gaseous state and spread across the room. This is nothing but chemistry, Kayo!" exclaimed Minu.

"Without chemistry we would not have plastic, CDs or DVDs, iPads, cars, medicines, insecticides, soap, photography, TVs, computers... the list is endless. In short, if it hadn't been for chemistry, you would have still been a cave man and me, a cave woman. Gagggaaa gee," Minu teased.

"That can't be true! What relation could these things possibly have with chemistry?" Kayo asked, puzzled.

"Well, chemistry is nothing

but the science that deals with composition, properties and chemical behaviour of matter. And everything that exists is matter in some form. Properties of matter are either physical or chemical. Properties such as colour, smell and texture are physical while chemical properties describe changes that take place in the chemical identity of a substance when it reacts with other substances. For example, what happens if something burns or boils?" elaborated Minu.

Kayo could not believe his ears. Was chemistry really that simple? Why did it always look complex? Deep in thought, he sat down and turned on the air conditioner, for it was getting too hot.

As soon as he did this, Minu snatched the remote from his hand and said, "This, dear Kayo, is chemistry too!"

"No wayyyy! Don't kid me Minu. This is electronics."

"I Am not kidding! It's simple - when a liquid converts into gas, it absorbs heat. The AC uses chemicals that easily convert compressed liquid into gas and back again, cooling the room down in the process," Minu replied.

"And Kayo, we wouldn't even be alive if it wasn't for chemistry. Chemical

reactions occur in our body every second, keeping us alive and sane! Chemistry doesn't only make lives easier, it makes life possible!" she concluded.

"Ok... ok, I get it. But, it will take some time for all this to sink in," Kayo muttered.

"Yeah, take your time. But hey! Why did you come over?" asked Minu.

"Oh yes, I completely forgot about that. Minu I have no clue what the theme of my birthday party should be. Help me out!"

◆ "How about chemistry?"

"Hahaha, no way!"

"Why not? Think about it. There is so much to explore. Let's have a deal. Research today and if you do not like it, turn it down tomorrow?"

"Ok, deal."

The next day, by 6:00 a.m. Kayo called up Minu.

"Kayo, it is only 6! It's vacation time. Let me sleep!"

"No, I have been waiting since 4! I need to show you something."

"Ok fine. Give me some time. I need to brush my teeth."

Minu reached Kayo's home in 15 minutes. As she entered,

she noticed something very funny - the smell of chemicals! Was Kayo awake all night experimenting?

Before she could ask, Kayo placed a bowl full of liquid in her hand and said, "Here, hold this."

He placed a paper cut-out of the Sun in the bowl. The rays of the Sun were made out of blue strips. As soon as the paper-sun came in contact with the fluid in the bowl, the rays turned red!

"Wow, Kayo!" exclaimed Minu.

"He... he... he. That is the magic of litmus paper. The Sun rays are made of just that. When placed in an acid, blue litmus paper turns red."

"You also get red litmus paper. It turns blue when it comes in contact with alkaline solutions," Kayo continued. He took some red litmus strips from his table drawer and dipped them into another bowl filled with liquid. They turned blue!

Minu was dumbstruck.

"You know about acids and bases?" she asked.

"Yes, I do. What's the big deal about them? All matter is made up of molecules. Molecules are further divided into atoms. When atoms are electrically charged, they are called ions. Acids and

bases are determined by the number of Hydrogen (H^+) or Hydroxide (OH^-) ions present in a solution. If there are more H^+ ions, then it's an acid. Bases have more OH^- ions. Water has an equal number of both ions. Hence, it is a neutral solution."

◆ Minu was amazed at Kayo's overnight progress. Before she could react, Kayo switched the white lights in the room off and turned on a small blue light. He then held up his hands and voila! They were glowing. "See? This trick is possible thanks to petroleum jelly and the blue ultraviolet light!"

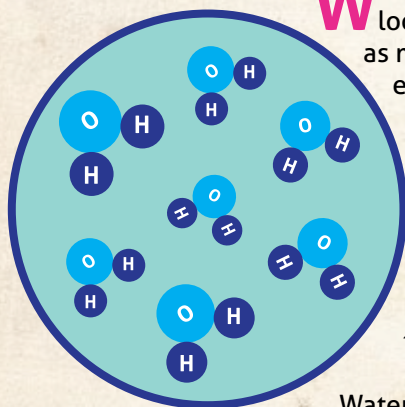
"Do you know that these aren't just tricks? They help us in our day-to-day life too. For instance, forensic experts use ultraviolet light to detect traces of blood and other body fluids at crime scenes," added Minu.

"Yes. And now, thanks to you, I have my party fully planned! There are numerous chemistry related tricks that I can do and amaze people. This is going to be my most memorable birthday!"

Minu could not believe her ears. She almost fainted. Kayo was not only expressing his love for chemistry but he was also thanking her! Overnight, Kayo had turned into a complete GEEK! And this proved to be one irreversible reaction. ■

WATER-WATER EVERYWHERE!

The one liquid life cannot sustain itself without is water. But do we really know water as well as we should? Let's take a closer chemical look at it.



Water Molecules

Water is made up of numerous small bits that are loosely attracted to each other. These bits are known as molecules. Molecules are not visible to the human eyes as they are too minute. If we were to compare molecules with grains of sand – just one teaspoon of water would contain about the same number of molecules as the grains of sand on a big beach!

Each molecule of water is made up of two atoms of hydrogen and one atom of oxygen. Atoms are the most fundamental particles of matter.

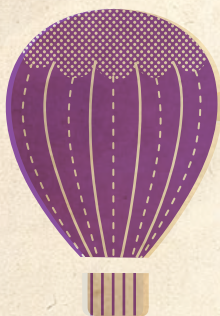
Water molecules are polar and attract each other. Hence, while they can move around freely, they do not lose contact. Due to this free movement of molecules, all liquids are fluid and can easily take the shape of any container.

When water is heated, the molecules gain energy and begin to move rapidly. This causes them to overcome the bonds with other molecules and turn into water vapour, floating into air.

This is why puddles on the road dry up faster under the Sun. Same is the case with wet clothes. This process through which water changes its state from liquid to vapour is known as evaporation.

Thus, water is all around us at all times - be it as vapour or in its liquid state. ■

Evaporation



Is air only Oxygen?

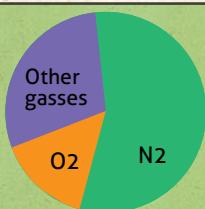
What is the air around us made up of? Just like water, let's give air a chance too - time to know it better!

The answer to this question is a straight no. The air around us is not made up of only oxygen. It comprises of various gases.

The major components of air are:

Nitrogen, N₂ - 78.08% and Oxygen, O₂ - 20.95%

The other gases that are found in much smaller quantities include:



Argon, Ar	0.93%
Carbon dioxide, CO ₂	0.033%
Neon, Ne	0.0018%
Helium, He	0.00052%
Methane, CH ₄	0.0002%
Krypton, Kr	0.00011%
Nitrogen oxide, N ₂ O	0.00005%
Hydrogen, H ₂	0.00005%
Xenon, Xe	0.0000087%
Ozone, O ₃	0.000001

Besides these gases, like we discussed earlier, air also consists water vapor. The percentage of vapour present in air varies tremendously as per the location, temperature and time. Of course, dust is a major component of air too.

Just like water, air is filled with molecules. But, air is made up of various gases and hence, contains various kinds of molecules.

When we inhale, we take in all these gases, but it is oxygen that gets absorbed by our blood stream. Hence, oxygen is vital for our survival. At standard temperature and pressure, two atoms of oxygen bind to form dioxygen, a colourless, odourless and tasteless gas with the chemical formula O₂. ■

Did you know? The molecules of gases are spread far apart, allowing them to spread out and occupy all possible area, be it an empty bottle or a room. This also allows us to exert pressure and compress gases into tiny spaces. When compressed enough, forces of attraction convert the gases into liquids. This change in state is reversible. A great example of this is the perfume we use.

WHAT MAKES SOLIDS SO HARD?

*By now, we hope that you know
the answer to this question!*

Solids are hard because their molecules are strongly attracted to each other. Hence, they are packed together at all times. This gives them an independent shape and they do not flow like liquids or disperse like gases.

When heated, the molecules of a solid gain energy and begin to vibrate, causing them to move a little apart. When solids are heated in excess, they expand. The opposite happens in really cold regions - solids contract due to extremely low temperatures.

One of the most important solids that exist as of date is the human body itself!

98.5% of the mass in a human body is made up of six elements:

Oxygen
Carbon
Hydrogen
Nitrogen
Calcium
Phosphorus

The remaining 1.5% of the human body mass is made up of more than 50 elements!

Did you notice that the two major components of air, water and our body are hydrogen and oxygen?



1.1% Phosphorus

1.4% Calcium

3% Nitrogen

10% Hydrogen

18% Carbon

65% Oxygen

Did you know?
Every organic molecule in our body contains carbon!



The Shine of Metal

Metals were hidden beneath the earth's crust waiting to be discovered. As humans evolved, they unearthed mother nature's wonders. Let's find out how this journey took place.

by Sarthak Sinha



Humans learned how to **smelt^G** metals in prehistoric times, more than 8000 years ago. The discovery and use of various useful metals - copper and bronze at first, then iron a few millennia later - had an enormous impact on human civilizations. The impact was so great that historians have divided ancient history into the Stone, Bronze and Iron Ages.

Stone Age was the time when humans used stone widely. They made tools with a sharp edge, a point and so on. This period lasted for about 3.4 million years, ending between 4500 and 2000 B.C.

The Earth's crust contains different rocks. Rocks are nothing but a mixture of metallic or non-metallic minerals. The metal from the metallic ones can be extracted and used for various purposes.

The first metals to be smelted were tin and lead. These did not have much impact on society as they were too soft to be used as effective tools.

The next metal that appears to have been discovered is copper. But copper needs fire of temperatures above 1000°C to be smelted. Hence, it could not have been smelted in normal campfire,

the temperature of which fall 200°C short of the needed temperature. Thus, it can be assumed that copper was smelted in pottery kilns.

It was in Asia Minor*, during 3500 B.C., that humans discovered the science of combining two metals to form stronger alloys. This gave birth to bronze - an alloy of copper with tin and/or arsenic in the right proportions.

With the advent of bronze, metals became hard enough to make heavier and stronger, and more resistant weapons became a reality.

Humans soon mastered the skill of smelting iron and making stainless steel too - leading to better equipment for agriculture, construction, ship building, warfare and many other fields.

Inspite of this advancement, how the prehistoric humans learnt to smelt is still a mystery. It could be a discovery that occurred by accident when humans noticed the **vitrification^G** of quartz in the sand struck by lightning. ■

* Asia Minor is the western most section of the continent of Asia and is the largest section of modern Turkey.



FOOD GOES FOR A STARCH TEST!

by **Kayomarz Bacha**

Most plants store food in the form of starch. Starch is a valuable source of energy for plants and people alike. Chemically, starch is nothing but chains of glucose molecules joined end to end.

CAUTION: Iodine is toxic. Do not consume it in any form. And do not touch it directly. Perform this experiment only under parental supervision.



To test the presence of starch in the food you eat daily, you need:

- A small plate
- Tincture iodine (available at medical stores)
- A variety of fruits, vegetables and food items
- An ink dropper
- Water

Step 01

Add some water to the tincture iodine (50:50) in the plate and make a solution.



Step 03

Use the ink dropper and drop some iodine solution onto each of the slices. If the food has starch, the area where you dropped the iodine solution will turn blue-black. ■



Step 02

Cut the vegetables, fruits and food items (bell peppers, onion, eggplant, cabbage, okra, potato, banana, cucumber and bread or anything available at your home) into slices.



Some food products have a high amount of starch while some do not. Try this experiment with various food items and email your observations to brainwave@ack-media.com in the form of a table. The best answer will win a nomination to our Student Board as well as the latest Amar Chitra Katha comic!

THE SMARTIES

BIOCHEMICAL WARS

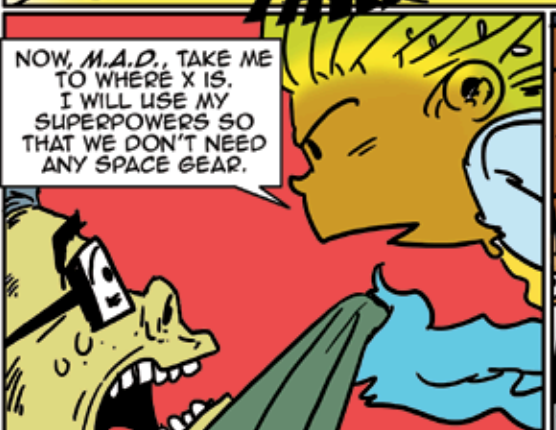
STORY: JAYADEV CALAMUR

ART & LETTERING: ABHIJEET KINI

LAST TIME, BHOO CAPTURED M.A.D. AND GRILLED HIM FOR X'S WHEREABOUTS. FINALLY...



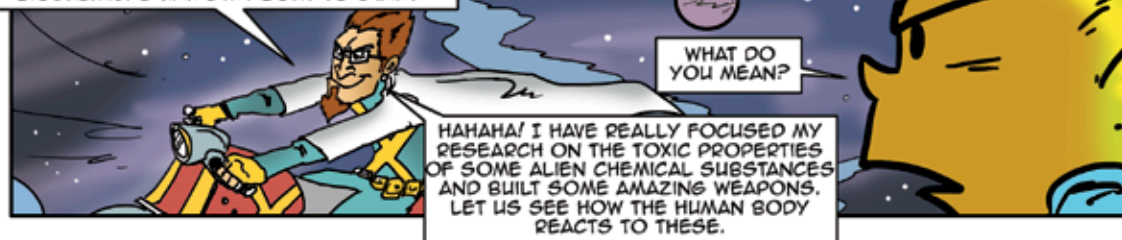
LISTEN TO ME, FRIENDS. THE UNIVERSE DOES NOT NEED ANOTHER WAR. GO HOME IN PEACE AND IF POSSIBLE, MENTOR THE HUMANS.

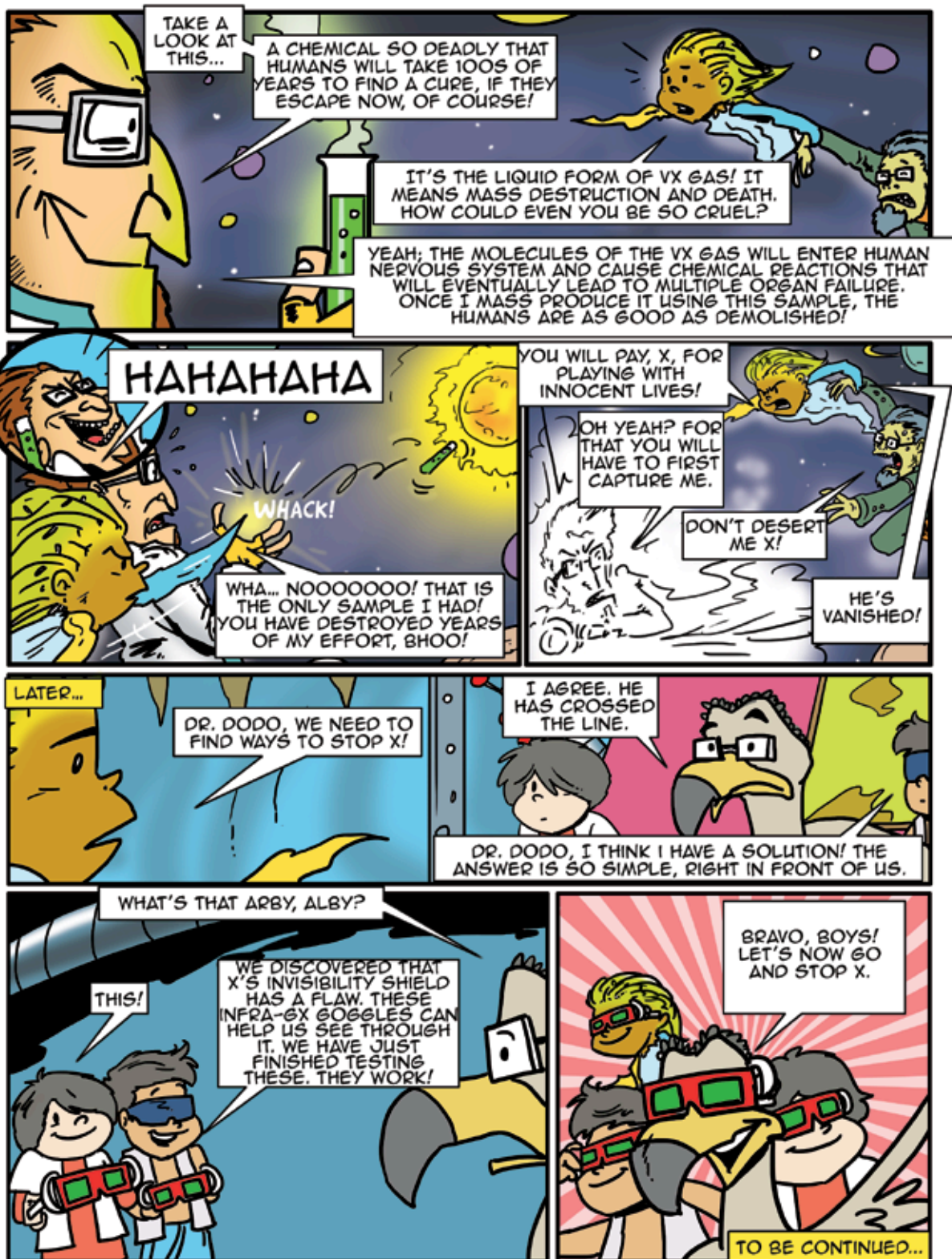


BHOO, WHAT A SURPRISE! I SEE YOU HAVE MANAGED TO OVERCOME MY ALIEN MISSILE OBSTACLE COURSE.



YOU'VE COME AT THE RIGHT TIME. WANT TO WATCH A DEMO OF THE TERRIBLE BIOCHEMICAL WAR I'M ABOUT TO START?







SOME ELECTROLYSIS FUN

by Kayomarz Bacha



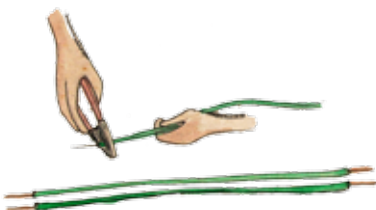
You need:

- 9V battery (available at electrical stores for Rs. 20)
- Two 12" copper wires (available at hardware stores for Rs. 10)
- Two regular HB pencils
- A glass
- Warm water
- A piece of cardboard

METHOD:

Step 1

Strip 1 inch of insulation off both ends of each wire.



Step 2

Fill the glass with warm water and add a little salt.



Step 3

Sharpen both ends of both the pencils.

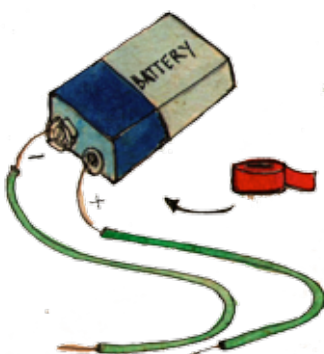


View the video at www.youtube.com/watch?v=l-LZVnxnjTs



Step 4

Connect one wire to the positive and the other to the negative end of the battery. Note: Use electrical tape if necessary.



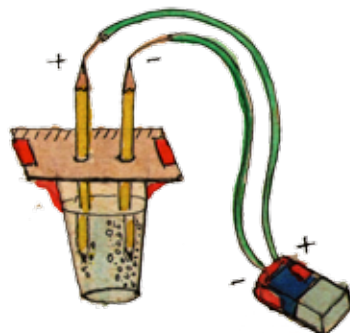
Step 5

Place the piece of cardboard over the mouth of the glass, make two holes and insert the pencils into the warm salt water through them.



Step 6

Connect the loose end of each wire to the lead of the open end of each pencil and watch what happens. ■



Why does this happen?

When you connect the wires to the battery, you will see bubbles appearing around each of the pencil leads that are dipped in the warm salt water. These bubbles float upward.

These bubbles are the components of water - hydrogen and oxygen - that have been split apart by the electricity as it travels through the water from one pencil to the other.

The pencil lead that is attached to the negative terminal of the battery collects

hydrogen gas while the one connected to the positive terminal collects oxygen.

Does one pencil collect more bubbles than the other? Which one? Why do you think this happens? Hint: Water's chemical name is dihydrogen monoxide. Each water molecule contains two hydrogen atoms and one oxygen atom.

The chemical equation:
 $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$

What is electrolysis?
What are its applications?

Research these questions and email your answers to brainwave@ack-media.com
The best answer wins a digital copy of our upcoming book - Amazing Science Fun-das!

Leap Frog, Leap.

by Pratul Venkatesh,
Age 10

I was busy petting my frog. It had recently grown into a frog from a tadpole. During that transformation, it had suddenly jumped, for the first time. It was an amazing moment. Immediately after that I got a brainwave - to make a transporter, a leaping transporter.

A leaping transporter that carries you through the sky and space would be awesome!

I started to build it in my dad's garage. In a few days, I was staring at my marvellously constructed leaping transporter fitted with the world's hugest, most resistant and best shock-absorbing spring. I had fitted it with a supercomputer, which could take me to the place I searched on 'Google Maps'.

On my first trip, I took my

frog with me since it was because of the frog that I built this mind boggling machine. As the machine is something that leaps, I typed in Australia, the home of the very famous leaping animal - the kangaroo. The kangaroo is one of the few animals that leap to move.

I reached Australia in around five minutes. I witnessed an amazing sight - a kangaroo was training its little one. My frog looked at the kangaroo as if he

was talking to him.

We next visited the Prairies, where many rabbits live. I reached the location in ten minutes. A rabbit was standing behind me. It was fluffy. Further ahead, I saw its cousin, the hare.

Soon it was dark and I returned home after what was my first adventure. I now look forward to many more, with my frog and leaping transporter. ■



Artwork: Kashmira Sarode

Email your science fiction stories to brainwave@ack-media.com
The most imaginative one gets published here and wins a surprise gift!



CLUED-IN WITH CHEMISTRY

by Kayomarz Bacha

Chemical reactions occur all around us, in our day-to-day lives. Some occur naturally while others are induced by humans for various purposes.

Chemical reactions occur when one or more substances chemically react to become different substances. Some of these are reversible and some are not.



Photosynthesis



Rusting of Iron



Burning a matchstick



Cooking (popcorn, cake, pancakes, etc.)



Rotting of fruits and vegetables



Cooking rice



Burning gas

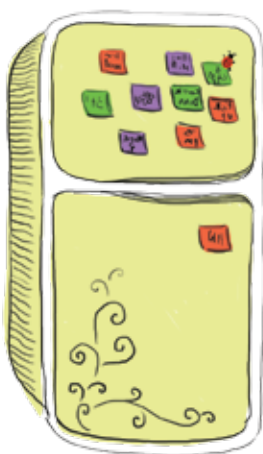
Research the chemical reaction taking place in each of the above mentioned scenarios. Email your responses along with the chemical equations for each to kayomarz.bacha@ack-media.com and you can win a cool ACK animation DVD worth Rs. 1450!



Magic in Mistakes

by Pooja Bhatt

As it turns out, lab blunders are a very common phenomenon. But, very often, some miracles happen because of them.



Post-it Notes

In the year 1968, chemist Dr. Spencer Silver, working at 3M, USA was conducting research to create super-strong glue. Instead, Dr. Silver ended up with an adhesive that was weak, reusable and pressure sensitive. Since a lot of effort had gone into it, Dr. Silver promoted his creation within the company and outside for over five years. But, he did not succeed.

In 1974, Dr. Silver's colleague

Arthur Fry attended one of his seminars and used this glue to ensure that bookmarks don't fall off from his book. He developed the idea further and 3M launched the product, *Post-it Notes* in 1977! ■



Did you know?

The typical yellow colour of the Post-it too is by mistake. The lab next-door to the Post-it team only had scrap yellow paper, which they initially used.



Coca-cola

The cool drink, when invented, was not so cool after all! Coca-cola came into being in a chemistry lab in the year 1886 when a pharmacist named John Pemberton cooked up medicinal syrup to cure people who were tired and nervous. When

Pemberton and his assistant tasted this mixture with ice, they found it tasty. While making the second batch, Pemberton accidentally added carbonated water to this and thus, the way humans consumed beverages changed completely. ■

Scotchgard

Patsy Sherman was among the few women hired by 3M. In 1952, she was working towards developing a new kind of rubber for jet aircraft fuel lines. One day, her assistant accidentally dropped a bottle of **synthetic latex**^G that Sherman had made. Some of this mixture splashed on the assistant's

canvas tennis shoe. Sherman then noticed that the spill could not be washed away, and that the area of the canvas shoe could not be soiled by any means - it repelled water and oil. Thus, scotchgard, a stain repellent and durable water repellent was born. The rest, as they say, is history! ■



Artwork: Kashmira Sarode

Power packed Periodic Table

by Priyanka Talreja

Periodic table – the name itself sounds intimidating, right? But it isn't intimidating at all! It is simply a table in which all the elements known to us are arranged in groups as per their chemical properties. The periodic table forms the base of modern chemistry.

A Russian chemistry professor named Dmitri Mendeleev developed this table in 1869. Mendeleev arranged the 65 elements (then known) in rows or columns, as per their atomic weights and recurring chemical properties.

Mendeleev left gaps in his table when it

seemed that the corresponding elements were not yet discovered. Using his periodic table, he predicted the properties of these missing elements. Most of his predictions were subsequently proved correct! This table has since then undergone numerous revisions. Today it contains 118 elements!

This table is used by chemists to organize, and study existing elements. It also helps them predict the properties of new elements. They can apply the data in experiments as simple as forming water from H and O₂ or as drastic as making hydrogen bombs! ■

Meet the Mercury Thermometer

by Priyanka Talreja

Did you know that the first ever device invented to measure temperature was known as a thermoscope? The thermoscope was at best a thermometer without a scale! If something was getting hotter, a thermoscope would reflect that. But, it would not measure the variations. Also, it was not sealed and hence, was sensitive to air pressure as well as temperature.

The thermometer as it is known to us today came into being much later. In 1709, Daniel Gabriel Fahrenheit invented an alcohol thermometer. By 1714, he replaced the alcohol with mercury.

The chemistry behind it: A mercury thermometer works on the basic principle of thermal expansion. Heat from our body is transferred the mercury in the thermometer through the glass tube. Then, the mercury molecules gain energy and start vibrating, leading to a greater distance between the molecules. Hence, it expands. Once the expansion stops, the temperature reading is noted down. Similarly, when it comes in contact with substances that are at a lower temperature than the room temperature, mercury contracts.

Mercury is widely used in thermometers because it is the only metal that remains in its liquid form over wide ranges of temperature and pressure. It has the capability to measure a wide range of temperatures accurately. Mercury is also easily visible and does not stick to the glass walls of the thermometer. ■

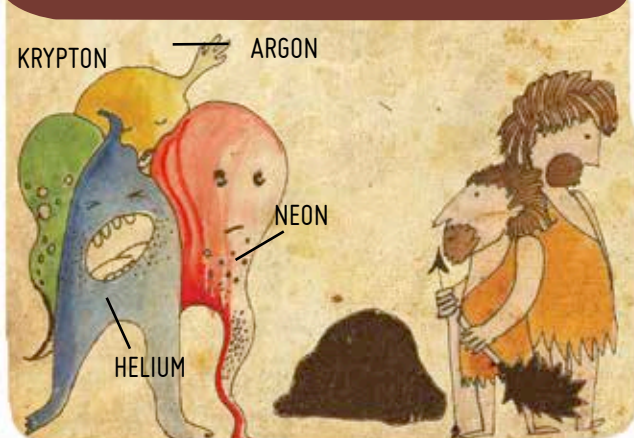




THE NOT-SO-NOBLE GASES

WRITTEN BY PRIYANKA TALREJA
ARTWORK BY SAUDAMINI TAMBAY

HUMANS TOOK FOREVER TO EVOLVE. GASES HAD BEEN THERE SINCE THE BEGINNING OF TIME. SO, THEY WERE THOROUGHLY BORED.

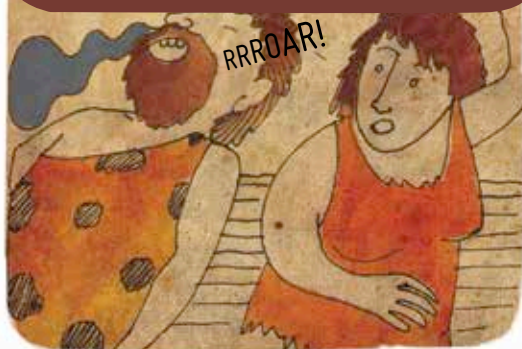


HELIUM BEING THE MOST NOTORIOUS OF THE LOT CAME UP WITH A PLAN TO PLAY PRANKS ON THE PRIMITIVE HUMANS.



We are gases, let us get together and cook up some fun. These humans are taking forever to discover us. No one is experimenting with us. I'm depressed!

ALL GASES AGREED. THEY GOT TOGETHER AND MADE WEIRD COMPOUNDS. SOME COMPOUNDS WOULD MAKE A HUMAN ROAR INSTEAD OF SNORE...



WHILE ANOTHER WOULD MAKE HUMANS GET UP AND JUMP IN THEIR SLEEP.

OZONE, WHICH WAS PROTECTING THE EARTH SAW THIS. IT WAS NOT HAPPY AT ALL.



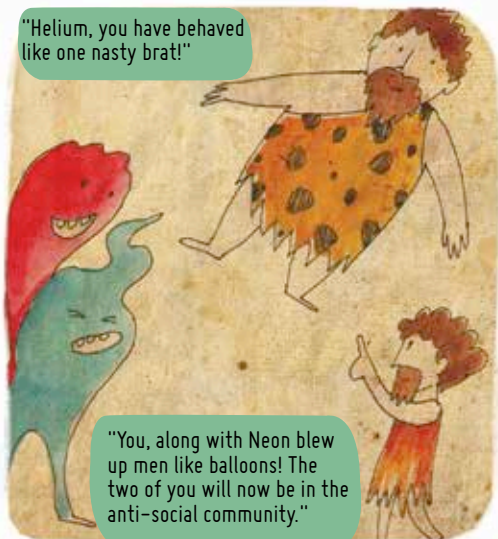
You gases have behaved very foolishly. A bunch of you will no more be able to socialize with others. You will be anti-social for as long as the Earth exists!



OZONE PICKED UP THE MOST NOTORIOUS ONES AND TOOK AWAY THEIR RIGHTS TO SOCIALIZE. THESE GASES COULD NOT MINGLE WITH ANYONE. THEY WERE NOW INERT!



"Helium, you have behaved like one nasty brat!"



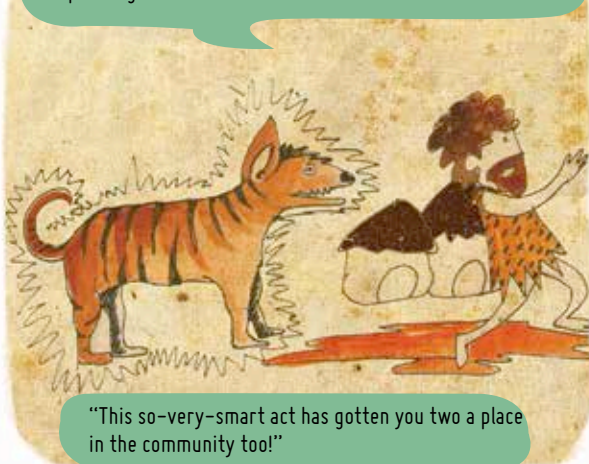
"You, along with Neon blew up men like balloons! The two of you will now be in the anti-social community."

"Krypton and Argon – you got together, created lightning arcs and scared innocent humans to madness!"

"This act qualifies you two to be anti-social community members."

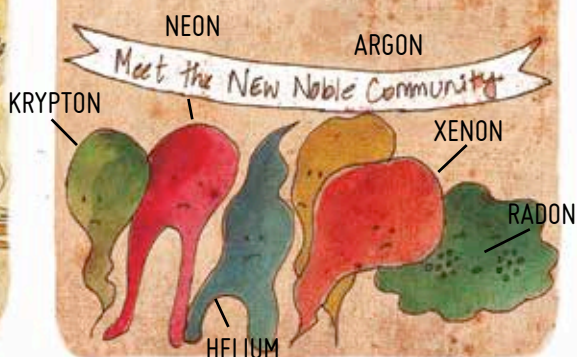


"Finally Radon and Xenon you made an animal look like a sparkling-zombie and enter the caves of men!"



"This so-very-smart act has gotten you two a place in the community too!"

AND THAT IS HOW THE ANTI-SOCIAL COMMUNITY WAS FORMED. IN PUBLIC, THEY WERE CALLED THE NOBLE GASES (BY OZONE) IN THE HOPE THAT THEY WOULD BE INSPIRED TO BE NOBLE AND LESS MISCHIEVOUS.



But...



Hey! I have an idea! Big deal if I'm isolated! I will still play around with humans. I don't need help from anyone.

HEY! What just happened to my voice? Why is it so high pitched?



SQUEAK!
SQUEAK!

OZONE, LOOKED AT THIS AND HELPLESSLY SMACKED HIMSELF.

THE END.



The Chemistry of Life!

Dr. Jyoti Vora shares her love for biochemistry.

by Alby and Arby

Dr. Jyoti Vora studied microbiology in Wilson College, Mumbai and later pursue her Masters and Ph.D. in biochemistry. She did her post-doctoral studies at the Indian Institute of Technology Bombay. She currently heads the Department of Biochemistry and Food Science at Ramnarain Ruia College in Mumbai and conducts guest lectures all over the world.

She is a doctoral guide and the author of eight books published internationally. She has numerous research publications credited to her. She has also been conferred with the F.S.Sc. (Fellow of Society of Sciences) and has a CME (Continuing Medical Education) from the USA.

Q. Describe the life of a biochemist.

A biochemist is a professional with specialization in biochemistry. He/she studies and concerns self with the understanding of the “molecular logic of life”.

Q. How differently do biochemists view life when compared to physicists, chemists, botanists or zoologists?

Biochemistry is best described as super-chemistry due to the application of chemical reactions to life and living processes. It involves the holistic assessment of ‘cell to organism’ and ‘organism to cell’ orientation as well as the interaction of living organisms with their environment. Hence it uses the basic principles of physics, chemistry, botany and zoology to gain a deeper knowledge of what’s living.

Q. You have taught and done research for several years now. What is it that still excites you about the subject?


Its universal relevance, its dynamism (there is always something new to learn) and its dedication to human health and wellness.

Q. You have been part of an Antarctic expedition. Tell us about that exciting adventure.

It was tremendously educative, scientific and exciting. As part of this project, funded by the Department of Ocean Development in India, we studied all kinds of flora and fauna found in the



Artwork: Sarthak Sinha



deep sea regions that ranged up to the Antarctic. We also studied various **bio-active compounds^G**, plants and algae, and different resident animals like **sea anemone^G** from the view of pollution, ecological organization, isolation of bioactive compounds etc.

Q. How can a **pure science^G like **biochemistry** appeal to students, when they have options such as **biotechnology, Media Studies and Management**?**

Biochemistry as a subject is the fundamental of the sciences you have mentioned:

Biotechnology is the commercial application of biochemistry

Media today widely covers topics that are related to health, wellness, environment, disease management, etc.

Specialist MBA courses in Pharmaceutical Management, EXIM, etc. are offered to biochemistry students.

Q. What are the future options for a student if they take up **biochemistry as a career?**

Not just in biotechnology and pharmacy but also in health sciences, nutrition, medicine and genetics.

Q. What colleges across the country offer a full undergraduate programme in **biochemistry?**

The three colleges under the Mumbai University that are well established in this course are Mithibai college, Ramnarain Ruia college and Gogate college. There are several universities all over the country that offer this course.

Q. What route does one take after their 10th class to pursue a career in **biochemistry?**

Opt for sciences in your 11th and 12th. Then, major and also pursue post-graduation in biochemistry. ■

Did you know?

Biochemistry is the study of chemical processes in living cells and organisms. Biochemists provide new ideas and experiments that are essential to know how life works. They help us understand health and diseases better. They drive work in hospitals, university research departments, agriculture, food institutes, scientific law, cosmetic industry, forensic crime research, industrial laboratories, drug manufacturing, biotechnology and many more fields.

For any career related guidance, write to us at brainwave@ack-media.com



THE BIRTH OF A SUPER POWER

by Bhoomi

Chemistry has blessed many with super powers. There are amazing possibilities hidden behind the colourful chemicals and clinking test tubes!



avoiding friction. Flash also has the power to vibrate so fast that he can pass through walls through a process called **quantum tunneling**^G.

A genius in nuclear physics, Robert Bruce Banner works at the United States Defense Department where he oversaw construction of the gamma bomb. At the test site, teenager Rick Jones breaches security and enters the testing field. Banner manages to save the teenager but gets caught in the explosion and absorbs massive amounts of gamma radiation. That is how the Hulk was born.

Gamma rays have the highest energy content in the electromagnetic spectrum. They cause Dr. Banner to occasionally turn into a mutated humanoid monster with inhuman strength, durability and regeneration. He doesn't have the ability to control his rage. His anger is directly proportional to his limitless physical strength. The madder he gets, the stronger he becomes!

When lightning shattered a case full of chemicals and spilled them all over police scientist Barry Allen, he turns into Flash - a superhero with superhuman speed, endurance and reflexes. Flash has the ability to displace the air in front of him without coming into contact with it, thus

Enjoyed reading about these chemistry powered superheroes? Now, your job is to step into the secret laboratory in your mind and create one such hero! Mind you, your superhero should gain his powers via chemistry. You are absolutely free to cook up anything else! ■

Artwork: Somesh Kumar

Email your entries to brainwave@ack-media.com and you can win a chance to read each issue of our upcoming science fiction graphic novel (serial), the Time Gliders, even before we publish it!



Chemical overload

by Dr. Dodo



Factories, farms, houses and the like release huge quantities of waste every year. This waste may be in the form of liquids, solids, gases or sludge and can contain chemicals, heavy metals, radiation agents, pathogens or other toxins.

Chemical waste has been a major reason for the end of marine life in various natural water bodies. A current example of this is the beautiful Lake Bafa Nature Park – a lake and nature reserve situated in southwestern Turkey. This lake is home to remarkable biodiversity. It is home to 261 bird species, 25 plant species, 22 reptile species and 19 mammal species. But, all of this is now under threat. The lake's waters have begun turning

green and foamy, thanks to salinization and polluting discharges from factories and fish farms.

This kind of waste also harms humans, animals and plants that depend on water or sea food.

In spite of strict laws to prevent hazardous waste disposal, many of us continue to pollute natural resources adversely, affecting the bio-diversity and eco-balance across the globe. ■

Can you research ways in which such damage can be prevented? Email your solutions to brainwave@ack-media.com to get a chance to be nominated to our Student Board as well as win a surprise gift!

Rising water

by Kayomarz Bacha



MAGIC
SCIENCE

Take a plate and pour some coloured water in it. Place a candle in the centre of the plate and light it. Now, carefully invert a transparent glass over the lit candle. What happens?

Try this experiment by altering the amount of water, the number of candles, and the size of the glass. Note down the differences. ■

Perform this trick and email your observations to kayomarz.bacha@ack-media.com
The most enthusiastic response can win you a cool science toy worth Rs. 250!

To know the science behind this trick, visit www.youtube.com/watch?v=DFIMsKlvero

Communicate with Chemi-apps

by Priyanka Talreja

These animals use chemistry to interact on a day-to-day basis!

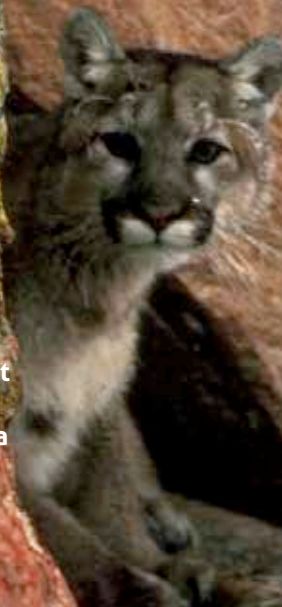
Animals don't have WhatsApp, BBM or Gtalk to communicate. But guess what - they don't need any of those! Why? Because they have pheromones!

Pheromones are secreted or excreted

chemicals that trigger a social response among the members of the same species. There are alarm pheromones, food trail pheromones, territory pheromones, and many others that affect behaviour or physiology of the receptors.

Do Not Disturb!

For Mountain Lions, marking their territory is very important. They like to live a lavish life and so, they mark their territory by setting up scent posts. They kick up piles of pine needles, dirt or leaves with their hind feet and urinate on the pile, releasing a cocktail of chemical compounds onto the leaves and creating a scent post. This scent post has a constituent that is unique to that animal and so, all others know who the post belongs to. Thus, a stern Do-Not-Disturb sign is created.





Taste the Food

Just like a fingerprint is unique to a person, a smell is unique to an animal. Snakes make the most of this. They taste the chemicals that a potential prey leaves behind by putting out their forked tongues. Once they pull their tongue back in, the chemicals collected on the tongue are transferred to the receptors on the roof of their mouths. This is how snakes trace their prey.

The Queen is Here

The queen bee is the center of attention of all other bees. She commands respect and expects the worker bees to feed and groom her. She does this thanks to her pheromones! The queen bee releases a set of chemicals that is a mixture of alcohols and organic acids. The scent of this set of chemicals is so strong that it affects the social behaviour of the entire hive! Via this scent, the queen controls the maintenance of the hive, swarming and other routine activities.



The Ant Siren

Ants work hard and in huge colonies. Hence, it is essential for them to communicate. For this, they take the help of chemistry. When an ant is disturbed, it releases chemicals that can be detected by other ants centimeters away! This creates an atmosphere of panic throughout the colony. All the ants keep secreting the alarm pheromone till the emergency is resolved. Once resolved, they quietly return to the tasks they were performing before the alarm pheromones were set off. ■





THE TIME TRAVELLING KUMARS

Episode 7

Sherlock
Diaries - 1

Story by:
Priyanka Talreja

Artwork by:
Sarthak Sinha

In the last episode – Dinesh was separated from his parents during their time travelling adventure to Atlantis. Dinesh lands in 19th century London, right inside 221B Baker Street, the abode of the world's first and greatest science detective, Sherlock Holmes!

I am Sherlock Holmes. It is my business to know what other people don't.

Sir... Mr. Holmes, you!

I know you Mr. Holmes. The whole world knows you! I am so glad to meet you. I am from the future. My dad invented a time machine. We were returning from Atlantis and got separated. I was worried. But now, I am glad that it has happened.

I am a great, great fan of yours!

Sherlock Holmes, a detective of supreme quality, was highly suspicious about the course of events. He talked less and listened with rapt attention for hidden meanings.

I am the last and highest court of appeal, in detection.

Wait till my parents and friends hear about this! Mr. Holmes, may I ask you a few questions? I have read every book of yours and have very many doubts. How would you describe yourself?

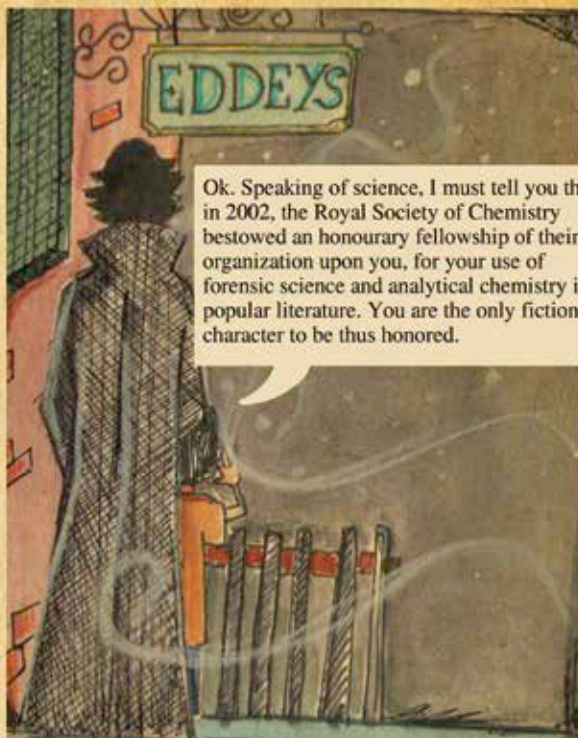
Wow... so, how do you start your quest towards a mystery? What do you do when a client comes to you?

I listen to their story, they listen to my comments, and then I pocket my fee.

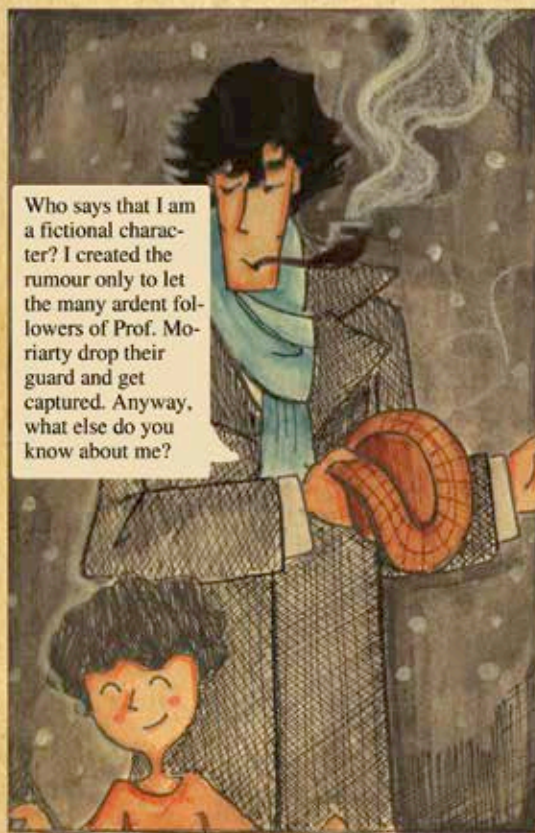


Hehe, that's a cool way of putting it. Could you please define detection for me?

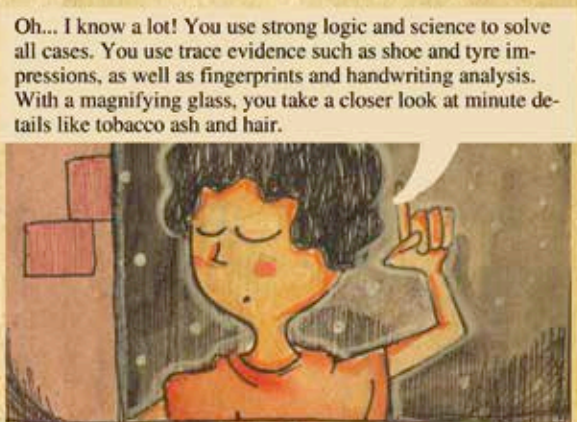
Detection is, and ought to be, an exact science, and should be treated in the same cold and unemotional manner.



Ok. Speaking of science, I must tell you that in 2002, the Royal Society of Chemistry bestowed an honorary fellowship of their organization upon you, for your use of forensic science and analytical chemistry in popular literature. You are the only fictional character to be thus honored.



Who says that I am a fictional character? I created the rumour only to let the many ardent followers of Prof. Moriarty drop their guard and get captured. Anyway, what else do you know about me?



Oh... I know a lot! You use strong logic and science to solve all cases. You use trace evidence such as shoe and tyre impressions, as well as fingerprints and handwriting analysis. With a magnifying glass, you take a closer look at minute details like tobacco ash and hair.



Beyond that, you also use analytical chemistry for blood residue analysis as well as toxicology examination – the study of symptoms, mechanisms, treatments and detection of poisoning.

Sherlock Holmes's technique has worked. He was silent and Dinesh has blurted out a lot of facts. This was enough for him to believe that the boy was not lying and was harmless. Holmes now played on. After all, who is not averse to praise?



Mr. Holmes, Please share some of your skills with me.

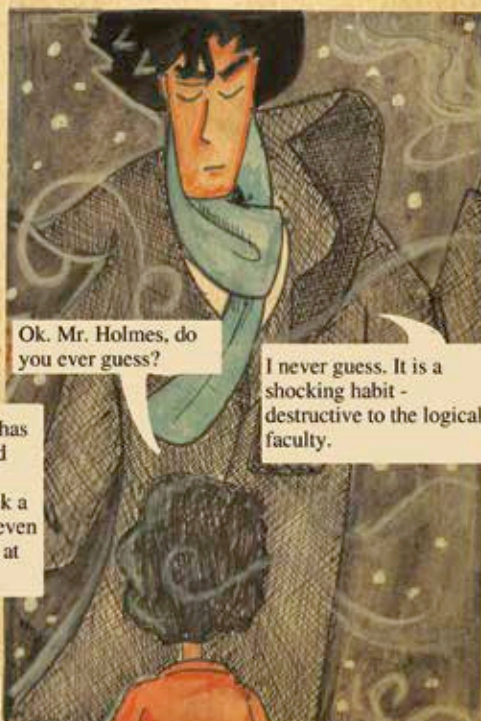


A conjurer gets no credit once he explains his tricks. If I show you too much of my methods, you will come to the conclusion that I am a very ordinary individual after all.



Oh no Mr. Holmes, that will never ever happen. I am your biggest fan!

Perhaps, when a man has special knowledge and powers like I do, it encourages him to seek a complex explanation even when a simpler one is at hand.



Ok. Mr. Holmes, do you ever guess?

I never guess. It is a shocking habit - destructive to the logical faculty.



What is the one tip you would like to share with anyone aspiring to be a detective?

A man should keep his little brain attic stocked with all the furniture that he is likely to use, and the rest he can put away in the lumber-room of his library where he can get it if he wants.



And what according to you are the three most critical things a detective must always adhere to?

1. There is nothing like first-hand evidence

2. It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.

3. ...

Just then, there was a knock on the door and a gentleman barges in, puffing and panting.



I need your help Holmes! Misery has befallen me at this odd hour of the night. I need you. This is urgent!



To be continued...

A placebo is a fake medicine that can have a positive effect on us, simply because we've been told that it's real. Placebo is Latin for 'I will be pleasing'. This happens because our central nervous system is powerful enough to translate strong feelings into actual physiological responses.

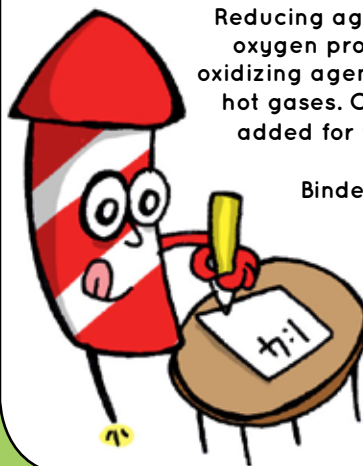
Cheats use this to fool gullible people into paying for worthless services.



A firework is basically a chemical reaction.

Fireworks contain the following reactants: an oxidizing agent, a reducing agent, a colouring agent, binders and regulators.

Oxidizing agents produce the oxygen that allows the reactants to burn. Reducing agents burn the oxygen produced by the oxidizing agent, to produce hot gases. Colourants are added for visual effects.



Binders hold all the ingredients together to form a lump and regulators control the speed of the reaction.



We swallow air along with our food. We also swallow carbon dioxide - like when we drink soda. These cause us to burp. In some cultures, burping after a meal is a compliment to the host.



Let's go 3D!

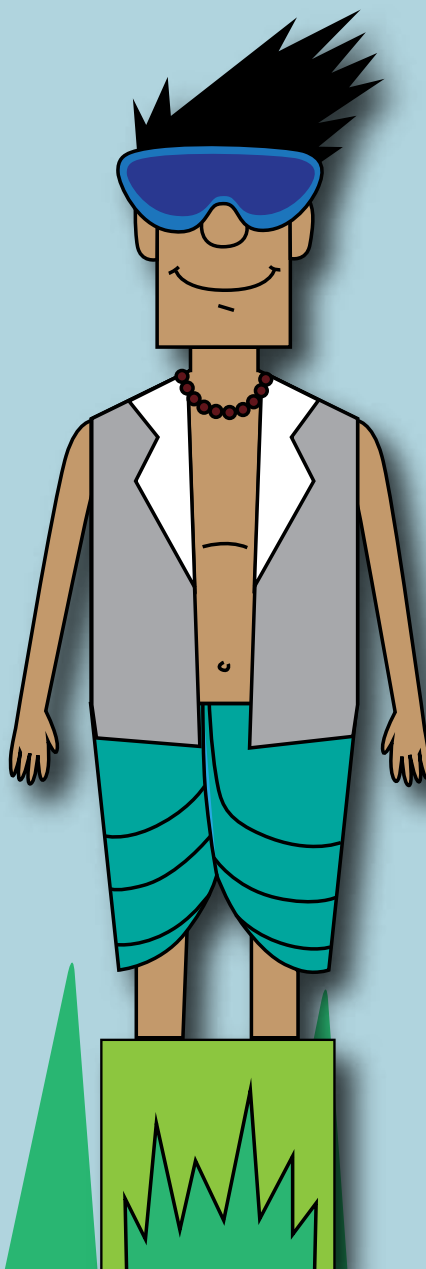
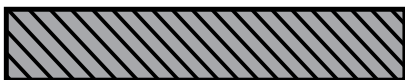
Make your own Smarty 3D paper toy - here's Arby.

To know more about the Smarties, turn to page 6.

You will need:

- This page
- Scissors
- Glue

Apply glue to parts which are marked like this:



Make all the 3D paper toys we publish in the next six issues, take pictures while posing with them and email the pics to brainwave@ack-media.com

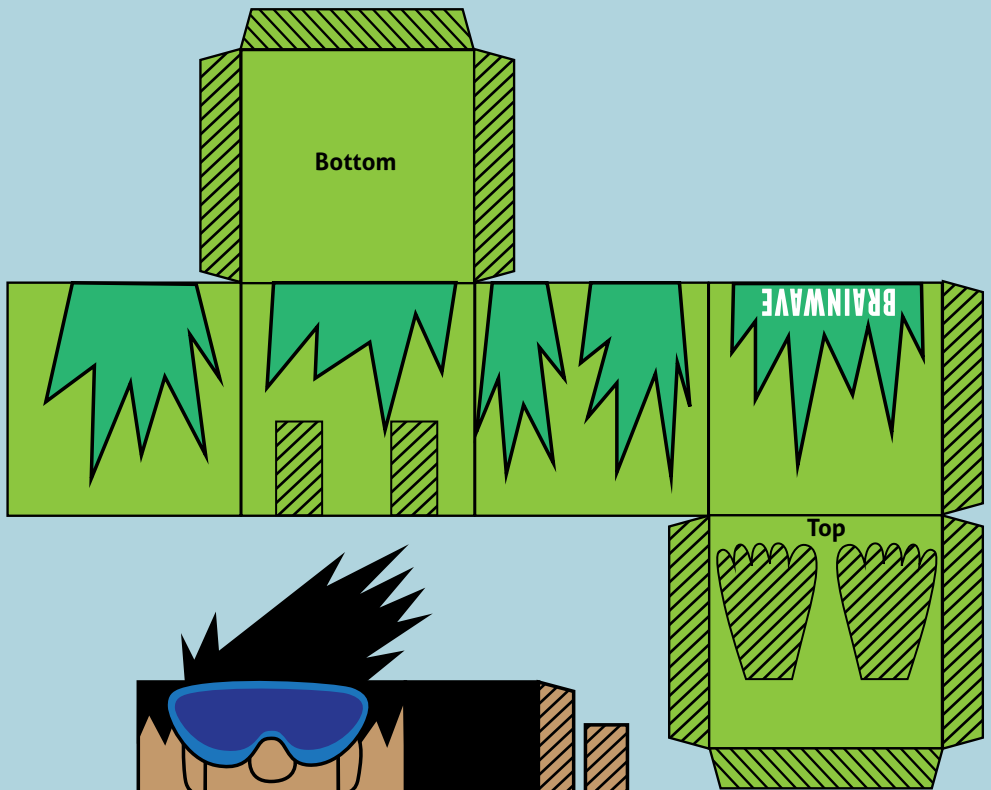
Top 5 participants get a digital copy of our upcoming Smarties comic book - for free!

View the video at www.youtube.com/watch?v=HDFod0jy1sY

METHOD:

Step 1

Tear this paper out and paste it onto a cardboard sheet that is 3-4 times thicker than a normal paper. Then, cut out the green part, Arby's body and hands.



Step 2

Form a box out of the green part and paste the edges together, with glue.

Step 3

Paste the edges of Arby's body to make it look like the image on page 42.

Step 4

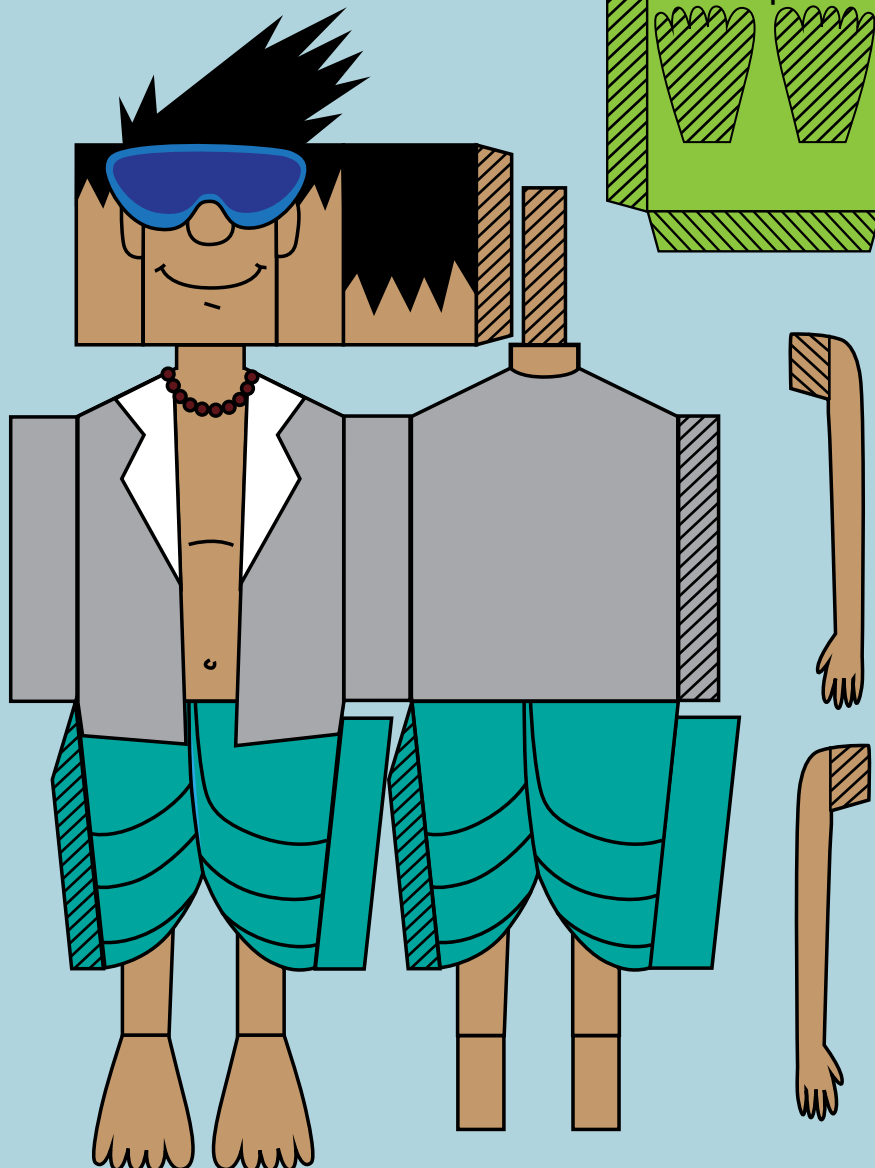
Paste each hand to each side of the body.

Step 5

Paste Arby's feet onto the green cube and make him stand.

Note: When in doubt, refer to the YouTube video.

Your Arby 3D paper toy is ready!





Win gifts throughout the year while you learn with fun!

Every month, the best team wins goodie-bags with posters, comics, CDs, cool BW friendship bands and more.

At the end of each year, the top 5 teams win the BW Fun-do Band 'Hall-of-Fame' certificates, mementos and t-shirts! The top most team will also win a rolling shield.

www.bwmag.in/fun-do-band

5 easy steps!

Step 1

Form a team with four other friends who are not subscribers of Brainwave.

Step 2

Give your team a name (e.g. The Smartensteins) and choose a captain.

Step 3

Email the full names of your team, members and captain to brainwave@ack-media.com

Step 4

Click on the website link that we email to each of you and register.

Step 5

As a team, perform DIY (P24), Toy Box (P8), Eye See (P27) and Magic Science (P35) every month. Submit your observations and start winning!

Go, gather your friends now and have five times the fun!



We all have teachers who inspire us to love science and to ask questions with an open mind. They could be at school or they could be friends and family members. Nominate them for the BW science super-teacher awards and let the world know about them!

If your nominee wins, you get a cool gift too!

Email their name and school along with 100 words on why you are nominating them to brainwave@ack-media.com

Treasure Hunt!

The Treasure Hunt is back. And this time, it is very simple! There is just one riddle that you need to solve to unearth the theme of the next issue:

*I am all around you; they say I am a science,
In all life, you will find my presence.*

*Without studying me, thyself you will never fully know,
I make for better understanding of man, there you go!*

*I am the theme of the July 2013 issue,
Guess who I am, now.*

oooooooo

What are you still waiting for? Get started - the first and most accurate entry will win a gift voucher worth Rs. 250!

Email your answers to brainwave@ack-media.com with 'Treasure Hunt' as the subject. And remember - only one entry is accepted per person!



Treasure hunt idea: Veena Prasad, Artwork: Anurajini Singh

The BW Student Board members work with our editorial team and make a difference to the magazine.

In addition to this, their work is published in the magazine and they get to lay their hands on all BW products before anyone else - for free!

At the end of their tenure, we award them with certificates and an honourarium of Rs. 1250 each.

For more information, visit:
www.bwmag.in/student-board

BW STUDENT BOARD





p09

Chemical Equation: A chemical equation is the symbolic representation of a chemical reaction. The reactants are mentioned on the left hand side and the resultant products are on the right hand side.

The reactants and products can be written either as words or as chemical formulae.

Example of chemical equation in words:
Liquid water ==> Oxygen gas + Hydrogen gas

The same reaction using chemical formulae:
 $\text{H}_2\text{O} (\text{l}) \Rightarrow \text{O}_2 (\text{g}) + \text{H}_2 (\text{g})$

p20

Smelting: Smelting is the process by which metals are extracted from their ore as elements or simple compounds. This is done by heating them beyond their melting points. Oxidizing and reducing agents are often used to decompose the ore, drive off other elements such as gases or slag, and leave just the metal behind.

Vitrification: Vitrification is the transformation of a substance into glass.

p28

Synthetic Latex: Synthetic Latex is the water emulsion of artificially produced rubber or plastic. These are generally used in coatings (such as paint) or in adhesives.

An emulsion is nothing but the resultant mixture that is formed when two non-mixing liquids are mixed.

p33

Bio-active compounds: Bioactive compounds are extranutritional constituents that occur in small quantities in the food we eat. They are

being intensively studied to evaluate their effects on health.

Sea Anemone: Sea anemones are a group of water-dwelling predatory animals.

Pure Science: Scientists who do experiments to learn more about the world are practicing pure science. When this knowledge is applied to solve practical problems, it is called applied science.

Sci-Q Time!

Finished reading the magazine?

We have an innovative contest instead of a quiz this time. Win it and a **mystery gift worth Rs. 500** is yours!

What you need to do:

There are a few mistakes in this magazine. They are either science or English grammar related. Identify as many of these as you can and email them to us at brainwave@ack-media.com

Please ensure that you mention the page and paragraph numbers of each mistake.

o o o o o o o o

To take part in some cool science initiatives, visit www.bwmag.in

Parents and teachers, here's something unique for you:

<http://www.bwmag.in/parent-teacher-expert-collaboration>

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Now, Brainwave is the perfect balance of science and fun, which will make you call your friends up and say, "Guys, let's play science!"

You get 48+ pages of comics, stories, experiments and contests. There is a Treasure Hunt too! You can win many exciting prizes and even be on our **Student Board**.

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WHAT IS BRAINWAVE?

Brainwave is a children's science magazine from the house of Amar Chitra Katha and Tinkle.

We understand that each child has a different aptitude and love for science. Hence, we simplify science into forms that excite them - comics, stories, fun-do activities, contests and fascinating facts.

Give your child a Brainwave, and science will be just another game!